A national laboratory of the U.S. Department of Energy
Office of Energy Efficiency & Renewable Energy

National Renewable Energy Laboratory

Innovation for Our Energy Future

Sustainability Report

2006

Introduction

The National Renewable Energy Laboratory (NREL) is the only national laboratory dedicated to renewable energy and energy efficiency technology research and development (R&D). NREL's world-class scientists, researchers, and analysts are devoted to a full range of R&D activities that move these technologies from the laboratory to the marketplace, and ultimately, into our homes, businesses, and vehicles.

Our core competencies allow us to develop and advance renewable energy and energy efficiency technologies more effectively through the full R&D life-cycle—from basic scientific research through applied research and engineering; to testing, scale-up, and demonstration.

NREL's core competencies are:

- Renewable electricity production and use
- Renewable fuels formulation and use
- Integrated energy system engineering and testing
- Strategic energy analysis

Established in 1974, NREL began operating in 1977 as the Solar Energy Research Institute. It was designated a U.S. Department of Energy (DOE) national laboratory in September 1991 as the National Renewable Energy Laboratory. NREL conducts research primarily for DOE's Office of Energy Efficiency and Renewable Energy. The Midwest Research Institute and Battelle operate NREL under the oversight of the DOE Golden Field Office.

Contents

Acknowledgments

The Sustainable NREL Master Plan implementation is managed by **Bob Westby**, Sustainable NREL lead; and **Ellen L. Parker**, Sustainable NREL coordinator.

The following NREL staff members have a role in implementing the master plan: **NREL Executive Management** (laboratory stewardship and direction); **John Shaffer** (environmental stewardship activities — site planning and new buildings); **Chandra Shah** (water); **Otto VanGeet** and **Anna Hoenmans** (electricity and natural gas use); (greenhouse gas reductions); **Chandra Shah** (green power purchasing); **Tim Peele** (transportation); **Karri Bottom** and the **Recycling Advisory Committee** (materials); **Maureen Jordan** (environmental management systems — including sustainability); **Theresa von Kuegelgen** (communications); **Laura Michael** (policies and procedures); **Kerry Masson** (public responsibility) and **Barb Stokes** (financial stewardship).

Message from the Director

Dan E. Arvizu

At the National Renewable Energy Laboratory (NREL), we believe that achieving sustainability in all our activities is the most effective way to do business and excel at our mission. NREL continues to demonstrate a high level of environmental stewardship and, over the past several years, has made significant progress toward becoming a sustainable site. Fiscal year 2006 has been a truly noteworthy year for NREL.

Two very significant accomplishments in 2006 included:

- *Achieving Carbon Neutrality* — In 2006, by capturing the benefits of on-site renewable energy projects and purchasing renewable energy certificates, we have reduced our energy use and greenhouse gas emissions such that the laboratory has achieved "carbon neutrality" in all its operations. The emissions offset on a life-cycle basis include electric and natural gas use, air travel, commuter and fleet vehicle emissions, and the energy associated with water supply.

- *Completing Construction of a Laboratory to Platinum Standards* — In July 2006, we proudly unveiled our newest laboratory facility, the Science and Technology Facility (S&TF). As this report was going to press in March 2007, the U.S. Green Buildings Council certified this facility at the Platinum level under its Leadership in Energy and Environmental Design (LEED) program. This makes the S&TF the first federal laboratory to receive a Platinum level rating.

Additionally, in 2006 we laid the groundwork to significantly increase our on-site renewable energy capacity. In addition to our current wind and solar projects, other renewable energy projects are being developed, such as a Renewable Fuel Heating Plant, which could offset up to 75% of our on-site natural gas use.

We strongly believe that the success of our laboratory is closely related to the success of our local community. Being involved with the community helps transfer NREL's knowledge of energy and environmental technology and practices to improve both the quality of our workplace and the community where we live and work.

Thank you for your interest in our efforts and achievements. We welcome your comments on our new report and suggestions for future reports.

Dan E. Arvizu
NREL Director

About Sustainable NREL

Sustainability, in the sense of an organization and its operations, is the simultaneous and balanced pursuit of economic viability, environmental health, and public responsibility over the long term through appropriate investment decisions and operating practices. NREL implemented its Sustainable NREL initiative in 2000 to formalize and proactively pursue sustainability in all its operations and practices. Sustainable NREL activities are well integrated with the laboratory's Environmental Management System to meet NREL's environmental stewardship goals. See the Sustainable NREL Web site at http://www.nrel.gov/sustainable_nrel/.

At NREL, we actively work to maintain a sustainable environment in our own workplace. We believe that our institution should use minimal resources (energy, materials, water, etc.) while receiving the maximum value from those resources used — along with balancing environmental, economic, and human impacts.

The goal of Sustainable NREL is to institutionalize sustainability at the laboratory. Significant progress has been made in achieving this goal of fully integrating sustainability into all laboratory operations and practices.

NREL Sustainability Vision

The vision of Sustainable NREL is to establish a formal change in laboratory culture, ensuring that every decision we make fully considers all resource implications. When sustainability is a part of everything that we do at the lab, we will know that we have achieved our objective.

Sustainability Management Framework

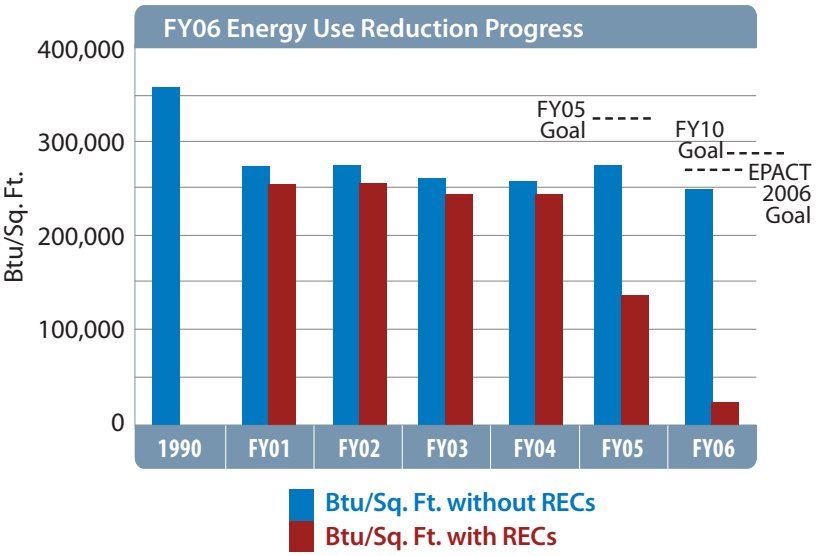
Economic Viability

Environmental Stewardship

- *Campus*
- *Water*
- *Electricity/Natural Gas*
- *Transportation*
- *Reduce, Recycle, Reuse, Rebuy*
- *Environmental Management*
- *Education/Communications*

Public Responsibility

Energy Use



NREL exceeded the FY06 federally mandated energy use reduction goals established by Executive Order 13123 for FY05 and FY10, and EPAct 2005 for FY06.

NREL manages its energy-use reduction activities through the laboratory's Comprehensive Energy Management Plan. The primary activities include energy efficiency retrofits; sustainable, energy-efficient new building construction; use of on-site renewable energy; purchase of energy-efficient equipment; extensive use of site metering and energy-management control systems; peak demand management; and energy education.

The major sources of energy use are building operation (particularly the laboratory-type buildings) and process loads associated with laboratory testing facilities. All major laboratory buildings are metered for electric and natural gas use. In addition, major process loads are separately metered for electric use. The total DOE-owned building square footage in the 1990 baseline year was 214, 208 Sq. Ft. In 1992 the Solar Energy Research Facility was built increasing the DOE-owned square footage to 385,599. A major increase of 71,000 Sq. Ft. occurred in FY06 with the addition of the Science and Technology Facility.

Renewable Energy Solutions

NREL's goal is to maximize the use of on-site renewable energy. In fiscal year (FY) 2006, wind and PV sources generated approximately 130 MWh. There are multiple on-site photovoltaic applications. At the National Wind Technology Center, when the wind turbines used during research and development activities are operating, the electrical energy they generate simultaneously offsets the on-site electrical load.

On-site renewable thermal energy sources include solar hot water systems, ventilation air preheat systems and extensive use of passive solar heating. In FY06, these sources produced some 10 MMBtu.

A major renewable energy project that will displace a majority of the laboratory's on-site natural gas use is planned for operation for the 2007–2008 heating season. The Renewable Fuel Heating Plant project will utilize a wood-fired (biomass) combustion boiler that will combust forest thinnings generated as a result of Healthy Forests Initiative[1] activities on the Front Range and other regional wood wastes. This plant represents a significant on-site renewables project, as it is projected to offset nearly 75% of NREL's current South Table Mountain campus natural gas use. The Renewable Fuel Heating Plant will be installed through an energy savings performance contract which is expected to be awarded in the spring of 2007. During 2006, the RFHP initial proposal was received; the notice of intent to award was issued; and the detailed energy survey was initiated.

The Renewable Fuel Heating Plant at NREL will displace on-site natural gas energy use. (Photo provided by Advanced Recycling Equipment of the Ameresco Chicago Compressor.)

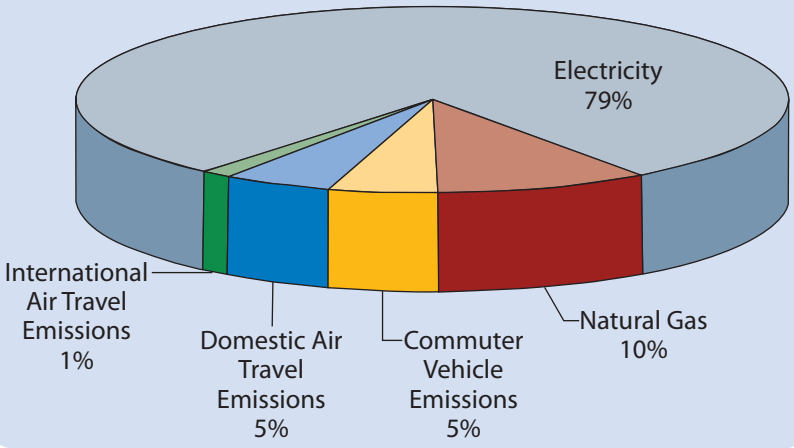
[1] For more information, see http://www.whitehouse.gov/infocus/healthyforests/.

Environmental Footprint

Zero-emission bus at hydrogen fueling facility.

SOURCE	Kg CO_2 Eq.
Electricity	23,552,000
Natural Gas	2,963,314
Commuter Vehicle Emissions	1,475,949
Domestic Air Travel Emissions	1,485,343
International Air Travel Emissions	428,305
Fleet Vehicle Emissions	90,838
Solid Waste Disposal	42,349
Water (Electricity Consumed)	16,349
Water (Natural Gas Consumed)	12,934
	30,067,380

FY06 CO_2 Emission Breakdown



NREL developed its "carbon footprint" to include other indirect sources such as those associated with staff travel to and from work.

In FY03, the laboratory developed an established methodology and conducted a life cycle assessment to develop its first CO_2 footprint. This footprint is updated each year using current year information on energy and water use, travel and solid waste.

This CO_2 footprint helps quantify the environmental consequences of the laboratory's total operation in terms of a functional CO_2 common denominator. The use of such a universal metric allows the laboratory to make decisions and measure progress towards climate neutrality, benchmark performance against goals and other similar institutions, and in general take responsibility for its actions.

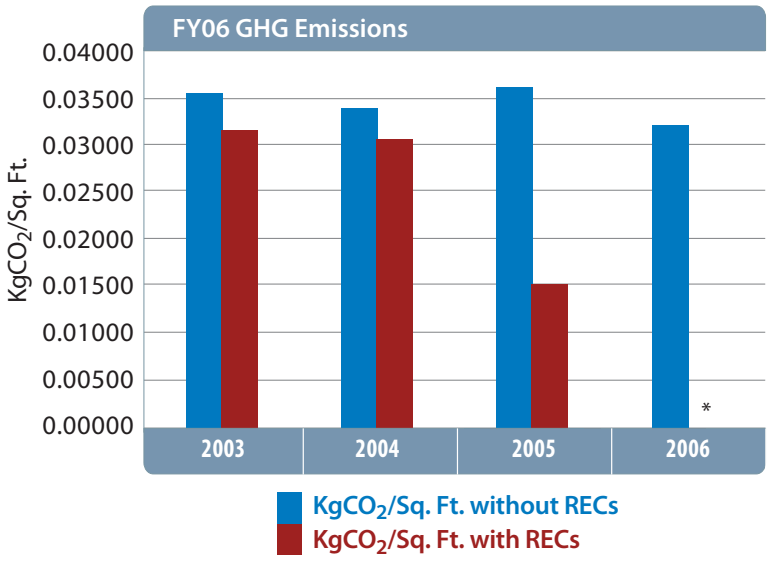
[2] Huffnagle, S.; Westby, R. *Sustainable NREL: Laboratory Life Cycle Assessment of Environmental Footprint*. NREL/CP-710-36529. Golden, CO: National Renewable Energy Laboratory, 2004. Available at http://www.nrel.gov/docs/fy04osti/36529.pdf.

Greenhouse Gas Emission Reductions

NREL greenhouse gas emission (GHG) reductions are a focal point of NREL sustainability activities. To this end, the laboratory has made a commitment to substantially increase its use of on-site renewable energy projects; require all new construction to exceed Federal Model Energy Codes; and continue its purchase of Renewable Energy Credits (RECs) to completely offset the laboratory CO_2 Footprint.
In the near term, when the Renewable Fuel Heating Plant comes on line for the 2007–2008 heating season, laboratory greenhouse gas emissions will be decreased commensurate with the significant decrease in natural gas energy use on the South Table Mountain campus.

The above reductions will be in addition to the 10% greenhouse gas reduction achieved in FY05 as compared to the FY00 baseline. The laboratory also expects to exceed the 3% FY07 reduction required by the new federal Executive Order 13423, Strengthening Federal Environmental, Energy and Transportation Management.

Denver's brown cloud, caused by pollution, is visible near NREL facilities in Golden, Colorado.



*REC purchases offset 100% of laboratory GHG Emissions.

Green Buildings

http://www.usgbc.org/

LABS FOR THE 21ST CENTURY®

NREL's newest laboratory building, the Science and Technology Facility (S&TF), was completed in 2006. The S&TF was designed and constructed and was on a track to exceed the requirements for the Leadership in Energy and Environmental Design (LEED) Gold Level. However, in March 2007 the S&TF was certified at the Platinum level, exceeding our original goal.

The S&TF was also constructed in accordance with the principles of the Laboratories for the 21st Century, a joint DOE/EPA initiative whose aim is to improve the environmental performance of U.S. laboratories. For more information on Labs21, visit the Labs21 Web site at www.labs21century.gov.

The S&TF received a DOE Federal Energy Management Program Energy Savers Showcase Award and the Jefferson County Board of Commissioners' Award for outstanding design of countrywide and regional significance.

NREL constructed its award-winning Science & Technology Facility using sustainability practices and principles.

Water Use

NREL made significant progress in systematically implementing life-cycle, cost-effective water use reduction measures. Since 2003, six FEMP Best Management Practices have been implemented in 100% of its facilities. These practices include educating staff about water conservation, xeriscaping, ultra-low-flush toilets, waterless and ultra-low flow urinals, , retrofitted faucets and showerheads, cooling tower management and distribution audits, and leak detection and repairs.

Water Management Features

The use of storm water detention ponds as a feature of the S&TF contributed to its LEED Platinum-level rating. The system was also designed so that storm water is collected on the butterfly roof over the office portion of the building. In addition, the building contains low-water-consuming fixtures, such as ultra-low-flow (0.5 gallon per flush) toilets. The cooling towers operate at six cycles of concentration, reducing make-up water requirements.

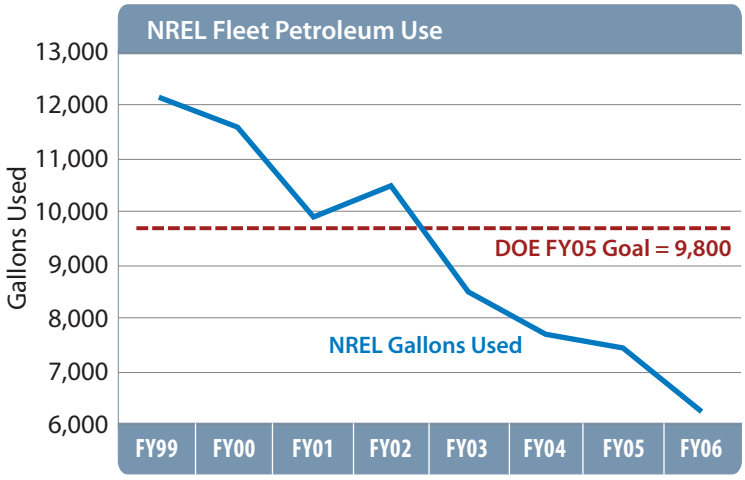
Xeriscaping outside of NREL's Thermal Test Facility reduces water use while remaining attractive.

S&TF butterfly roof under construction.

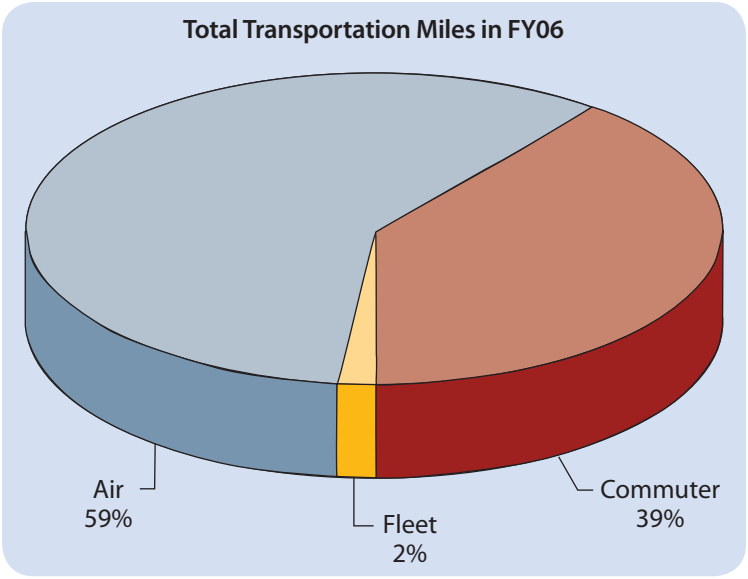
S&TF Water Efficiency and Quality LEEDs Credits

Leeds Credit	S&TF Description
Water Efficient Landscaping—Reduce by 50%	Planting plan. Reduced irrigation needs by 100%.
Water Efficient Landscaping—No Potable Use or No Irrigation	Surface drainage system. Utilizes captured rainwater to irrigate 100% of the site.
Water Use Reduction	Ultra-low-flow fixtures. 20% less water use than baseline fixtures.
Storm Water Management—Rate and Quality	Storm water detention. Predevelopment storm water discharge rate does not exceed post-development discharge rate.
Storm Water Management—Treatment	Detention ponds. Total suspended solids and post-development total phosphorous meet EPA Best Management Practices.

Transportation



NREL's FY06 petroleum consumption was 37% less than DOE's established goal of 9,800 gallons for the fourth consecutive year.



NREL employees traveled more than 15 million transportation miles in FY06.

NREL's transportation strategy focuses on the laboratory fleet and supporting employee alternative transportation opportunities.

Of NREL's 47 light-duty vehicles, 33 use alternative fuels, representing about 70% of NREL's total fleet. This use of alternative fuel vehicles decreased our petroleum use to 6,217 gallons in FY06, which substantially exceeds the DOE-mandated goal of 9,800 gallons or less by FY05.

In addition, since 1997, NREL has made a major commitment to the use of bio-based fuels in its fleet. Forty-seven percent, or 22 vehicles of the 47 fleet vehicles, are fueled by E85 (85% ethanol). The fleet used 9,868 gallons of E85 in FY06 which is more than 70% of the total fleet usage of 13,975 gallons fuel. NREL is also actively exploring the use of biodiesel. NREL is piloting B20 (20% biodiesel) fuel use in several of its large, diesel-powered vehicles.

Alternative Modes of Commuting

Identifying and supporting employee alternative transportation opportunities are key to achieving sustainability in transportation. The NREL-sponsored programs that support the use of alternative transportation include:

- A free EcoPass for NREL employees in Colorado as part of their benefits package. This allows employees to use the Regional Transportation District bus system free of charge.
- A shuttle service, which uses alternative fuel vehicles to reduce vehicle miles traveled between buildings in Golden, Colorado, on the South Table Mountain and Denver West sites.

- An alternative work schedule policy, which allows employees to work varying schedules (with management approval), including four-day workweeks.

NREL also works with the Denver Regional Council of Governments to provide commuting options for employees. For example, many NREL employees participate in its numerous carpooling programs. In addition, NREL hosts a booth at the council's Annual Bike to Work Day Event — a state-wide campaign promoting bike riding as a viable commuting option.

NREL also surveys its employees annually in order to collect metrics on alternative forms of employee commuting and guide the development of laboratory transportation programs.

Video Conferencing

Air travel represents 59% of the total miles traveled. In particular, the laboratory has two offices: one in Golden, Colorado, and the other in Washington, D.C. During FY06, the use of video conferencing mitigated the need for 121 domestic air fights totaling 336,300 air miles.

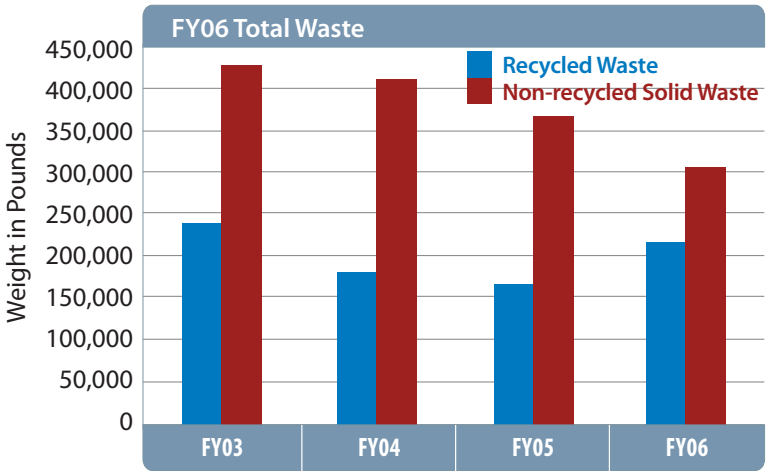
NREL employees participating in the Bike to Work helped reduce the vehicle miles traveled in the region by a total of 132,600 miles.

Table 1: NREL Commuter Survey Results

Walk	4%
Carpool	10%
Bike	15%
Bus	17%

47% of NREL's employees responded to the Commuter Survey distributed in June 2005. The numbers reflect the percentages of employees who opt for alternative modes of transportation at least one time per week.

Materials



Since FY03 NREL's non-recycled solid waste has decreased.

NREL's internal goal is Near-Zero Waste, which involves working to eliminate the laboratory's waste stream. It is also the next step in holistically coordinating and managing our recycling, rebuy, reuse, and reduce programs to systematically reduce waste. This goal is also a way for the laboratory to manage operating costs.

Recycling

Recycling is an established priority at NREL. NREL has a recycling station in each building for the common office materials. Materials recycled include mixed office paper, commingled glass, plastic, aluminum cans, corrugated cardboard, foam packing material, batteries, scrap metal, computer monitors, printer toner cartridges, and fluorescent light bulbs.

A recycling advisory committee helps oversee recycling activities and makes recommendations for improvements.

Rebuy

NREL has implemented multiple green purchasing activities. NREL purchases office supplies through an online catalog featuring environmentally preferable (recycled content) products. Green purchasing was integral to NREL's decision to create an electronic purchase card system in FY05. The system tracks metrics on green purchases made at the laboratory and encourages staff to purchase green products whenever possible.

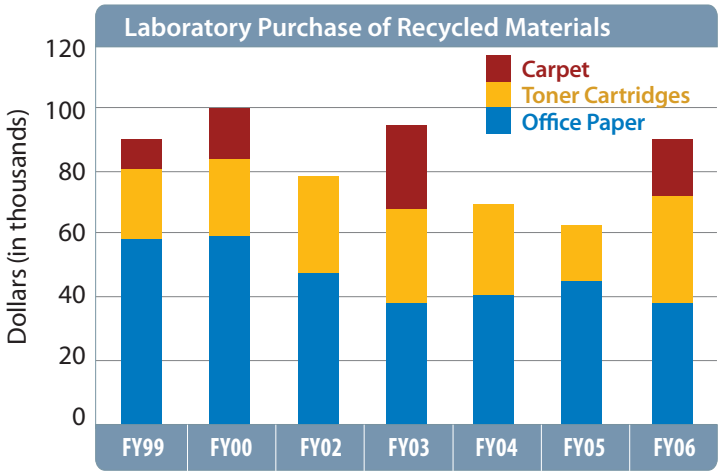
Reuse

NREL has established a Reusable Office Supply Center. Staff is free to take any office supplies needed and encouraged to drop off any new or good-as-new items.

Reduce

NREL has multiple ongoing activities designed to reduce material use including:

- Electronic communications and publications replace paper versions.
- Duplex modules were installed on all network printers, which default to the double-sided printing option.
- Staff reuses cardboard boxes, packing peanuts, plastic containers, and drums.
- NREL's Chemical Management System facilitates sharing chemicals and redistribution of extra chemicals.



Since 1999, 100% of all carpet, toner cartridges, and office paper purchased by NREL have contained recycled content. (2001 data not available.)

New Construction Activity

New construction offers several materials-related, sustainability opportunities including green purchasing and recycling. NREL received LEED points for materials management at its new S&TF. At least 5% of the total value of materials used in the project contained recycled content, and at least 20% of the total value of the materials and products used were manufactured regionally within a 500-mile radius of NREL. The contractor recycled about 75% of the total waste from the project.

Environmental Management

NREL has an established Environmental Management System in place to provide effective environmental stewardship of its federally owned sites and to minimize the environmental impacts of our activities wherever we are working, whether on our own sites or the sites of partners or subcontractors. It is a system of processes and documents that guide NREL's activities for implementing practices to protect the vegetation, wildlife, and natural resources of our sites; to comply with environmental requirements; and to encourage continuous improvement in environmental protection.

NREL prepares an annual environmental management report, summarizing NREL's environmental protection programs and activities. It includes a brief summary of how the program is managed in that area, including any permitting or notification efforts that have been completed during the reporting period. This report is available on the Sustainable NREL Web site at http://www.nrel.gov/sustainable_nrel/environmental_manage.html.

NREL has been a member of the U.S. Environmental Protection Agency National Environmental Performance Track since 2003 and is a Colorado Department of Health and Environment Environmental Leadership Program Gold Leader.

Public Responsibility/ Community Outreach

During FY06, NREL proactively reached out to new audiences and demonstrated its value to the educational and civic community. The laboratory set up two community displays: one at the Denver Museum of Nature and Science and another in Boulder, Colorado. The solar and wind exhibit at the museum was part of an educational exhibition called "Engineer It!" that was designed to teach students how things work. The museum attracts about a million visitors annually. A permanent solar and wind exhibit — funded by the Midwest Research Institute and Battelle on NREL's behalf — was built as part of a Boulder redevelopment project called the "Twenty-Ninth Street Wonder of Science." The exhibit is expected to attract three million consumers a year.

Each year, NREL hosts thousands of visitors who are interested in learning about the laboratory's research and development, strategic analysis, and applications activities. These visitors represent colleges and universities, the renewable energy industry, federal agencies, state and local government, private sector companies, legislators, and the public.

Of the more than 16,000 visitors to NREL last year, an increasing number — about 15% more than in 2005 — were walk-in visitors to the NREL Visitors Center. In 2006, the center's programs and special events included 10 public lectures; 17 consumer workshops; solar home tour exhibits and programs; and a day-long Smart Energy Living Expo. These activities attracted about 2,500 people.

Interactive exhibits at the NREL Visitors Center explain renewable energy technologies.

The NREL Visitors Center provides educational opportunities for visitors and the community.

The Path Forward

Bob Westby

We are pleased to be reporting for the third year on the state of sustainability activities at NREL. In this fifth full year of formal activities, we have seen an evolution of the laboratory's sustainability activities and significant progress towards our goal of institutionalization of sustainability at the laboratory.

We are focused on continuous improvement of our sustainability activities. Accordingly, we will be working to continue to engrain sustainability in the practices and operations across the laboratory working actively with the leadership of all laboratory organizational functions. This effort will be in part guided by the opportunities identified through the Global Reporting Initiative (GRI) assessment we have undertaken.

Going forward, here are highlights of some specific activities the laboratory will be pursuing to improve and enhance its sustainability activities.

Substantially Increase the Use of On-site Renewable Energy. The Renewable Fuel Heating Plant (RFHP) which is planned for initial operation for the 2007/2008 heating season is expected to offset 75% of the laboratory's current South Table Mountain campus natural gas use. The laboratory is also studying the feasibility of implementing large on-site PV systems. These systems would contribute to making new buildings Net Zero-Energy buildings.

Design and Construct Efficient, Sustainable New Buildings. All new buildings will continue to be designed to exceed Federal Model Energy Codes and meet LEED sustainability standards.

Continue the Commitment to the Use of Biofuels. Beginning in 1997, the laboratory made a major commitment to the use of bio-based fuels in its fleet. Forty-seven percent of its fleet vehicles are fueled by E85 which amounts to more than 70% of the total fleet fuel usage. We will continue to work to further enhance this commitment.

Implement Near Zero Waste Goal. The laboratory has established a Near Zero Waste goal which is supported by a comprehensive, integrated suite of recycling, rebuy, reuse, and reduce programs.

As an important part of our continuous improvement focus, we also want to invite your input and comments to our sustainability activities. It is also our public responsibility as a national laboratory to share the knowledge and experience we have gained in our sustainability activities.

Please feel free to contact me with your comments or if we can be of assistance.

Bob Westby
Sustainable NREL Lead
Robert_Westby@nrel.gov
303.384.7534

Awards and Memberships

2006 White House Closing the Circle Pollution Prevention Honorable Mention

Federal Energy Saver Showcase Award for Science & Technology Facility

Jefferson County Commissioners' Award for Design Excellence — Science & Technology Facility

U.S. Environmental Protection Agency Climate Protection Award

2005 U.S. Department of Energy Pollution Prevention Star Award for Green Fleet Team: Petroleum Reduction through Alternative Fuels.

U.S. Department of Energy Federal Energy and Water Management Award

2004 U.S. Department of Energy Pollution Prevention Best-In-Class Awards:

- Office of Energy Efficiency and Renewable Energy
- Sustainable NREL: New Building Program
- Sustainable NREL: Recycling Program
- Sustainable NREL: Education, Outreach and Information Sharing

U.S. Environmental Protection Agency National Environmental Performance Track

Colorado Department of Health and Environment Environmental Leadership Program (Gold Leader)

2003 University of Colorado Wirth Chair Award in Environmental and Community Development Policy

U.S. Department of Energy Departmental Energy Management Achievement Award: Effective Program Implementation — Sustainable NREL

2002 U.S. Environmental Protection Agency Climate Leaders Partnership: First federal laboratory member and one of seven members to establish a target reduction (target met in 2005)

Labs for the 21st Century: One of the first federal-sector labs to join the program as a pilot partner in 2002

Federal Energy Management Program Energy Saver Showcase Award for the Thermal Test Facility

2000 U.S. Environmental Protection Agency Green Power Partnership : Made commitment to purchase 10% of annual electric use in wind energy and first federal laboratory member

National Renewable Energy Laboratory

1617 Cole Boulevard, Golden, Colorado 80401-3393
303-275-3000 • www.nrel.gov

Operated for the U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy
by Midwest Research Institute • Battelle

NREL/MP-700-40800 • March 2007